

AMENDMENTS TO THE CLAIMS

Following is a listing of all claims in the application, which listing supersedes all previously presented claims.

Listing of the Claims:

1. (Currently Amended) A printed circuit board including a dielectric substrate and integrated with a two-axis fluxgate sensor, comprising:
  - a first rectangular ring type soft magnetic core arranged lengthwise along a first axial direction;
  - a first excitation coil ~~portion~~ winding around the first soft magnetic core;
  - a first pick-up coil ~~portion~~ winding around the first soft magnetic core;
  - a second rectangular ring type soft magnetic core arranged lengthwise along a second axial direction, the second axial direction being perpendicular to the first axial direction;
  - a second excitation coil ~~portion~~ winding around the second soft magnetic core; and
  - a second pick-up coil ~~portion~~ winding around the second soft magnetic core;

wherein the first soft magnetic core is disposed on a first surface [[side]] of the dielectric substrate and the second soft magnetic core is disposed on a second surface [[side]] of the dielectric substrate opposite the first surface, and

~~wherein the first excitation coil portion is electrically connected to the second excitation coil portion by a first via and the first pick-up coil portion is electrically connected to the second pick-up coil portion by a second via.~~

2-16. (Cancelled).

17. (Currently Amended) The printed circuit board as claimed in claim 1,  
wherein:

~~each of the first and second soft magnetic core cores~~ comprises a first parallel pair of bar-type portions extending along the first axial direction and a second parallel pair of bar-type portions extending along the second axial direction, the second parallel pair of bar-type portions being co-planar with and connected to the first parallel pair of bar-type portions,

the second soft magnetic core includes a third parallel pair of bar-type portions extending along the second axial direction and a fourth parallel pair of bar-type portions extending along the first axial direction, the fourth parallel pair of bar-type portions being co-planar with and connected to the third parallel pair of bar-type portions. [[and]]

the first and second parallel pairs of bar-type portions of the first soft magnetic core cores extend along a first plane that is substantially parallel to the dielectric substrate,

the third and fourth parallel pairs of bar-type portions of the second soft magnetic core extend along a second plane that is substantially parallel to the dielectric substrate, and

wherein each of the first and second soft magnetic cores serves as a closed magnetic path.

18. (Currently Amended) The printed circuit board as claimed in claim 17,  
wherein:

the first excitation coil ~~portion~~ separately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first axial direction, and

the second excitation coil ~~portion~~ separately winds around each bar-type portion of the third ~~second~~ parallel pair of bar-type portions of the second soft magnetic core in a solenoid pattern extending along the second axial direction.

19. (Currently Amended) The printed circuit board as claimed in claim 18, wherein:

the first pick-up coil ~~portion~~ winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction, and

the second pick-up coil ~~portion~~ winds around both bar-type portions of the third ~~second~~ parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction.

20. (Currently Amended) The printed circuit board as claimed in claim 17, wherein:

~~along a plane substantially perpendicular to the dielectric substrate and the first axial direction, the first excitation coil portion separately~~ winds around one of the bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first direction and the first pick-up coil ~~portion~~ separately winds around the other of the bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first axial direction, and

~~along a plane substantially perpendicular to the dielectric substrate and the first axial direction, the second excitation coil portion separately~~ winds around one of the bar-type portions of the third ~~second~~ parallel pair of bar-type portions of the second soft magnetic core in a solenoid pattern extending along the second axial direction and the second pick-up coil ~~portion~~ separately winds around the other of the bar-type portions of the third ~~second~~ parallel pair of bar-type portions of the second soft magnetic core in a solenoid pattern extending along the second axial direction.

21. (Currently Amended) The printed circuit board as claimed in claim 1 [[17]], ~~including a plurality of the first vias and a plurality of the second vias, wherein:~~

~~each of the first excitation coil portion and the first pick-up coil portion includes a plurality of first excitation coil upper portions on the first surface [[side]] of the dielectric substrate and a plurality of corresponding first excitation coil lower portions on the first surface [[side]] of the dielectric substrate, the plurality of first excitation coil upper portions being arranged further from the first surface [[side]] of the dielectric substrate than the plurality of corresponding first excitation coil lower portions,~~

~~each of the second excitation coil portion and the second pick-up coil portion includes a plurality of second excitation coil upper portions on the second surface [[side]] of the dielectric substrate and a plurality of corresponding second excitation coil lower portions on the second surface [[side]] of the dielectric substrate, the plurality of second excitation coil upper portions being arranged further from the second surface [[side]] of the dielectric substrate than the plurality of corresponding second excitation coil lower portions,~~

~~the plurality of first excitation coil upper portions of the first pick-up coil portion and the plurality of first upper portions of the first excitation coil portion corresponding correspond to a patterned first upper conductive layer [[film]],~~

~~the plurality of corresponding first excitation coil lower portions of the first pick-up coil portion and the plurality of first lower portions of the first lower portions of the first excitation coil corresponding correspond to a patterned first lower conductive layer [[film]],~~

~~the plurality of first excitation coil upper portions of the first pick-up coil portion being are electrically connected with corresponding the plurality of corresponding first excitation coil lower portions of the first pick-up coil portion by way of conductive respective ones of the second vias,~~

the plurality of second excitation coil upper portions correspond to a patterned conductive layer,

the plurality of corresponding second excitation coil lower portions correspond to a patterned conductive layer, and

the plurality of first second excitation coil upper portions of the first excitation coil portion being are electrically connected with corresponding the plurality of corresponding first second excitation coil lower portions of the first excitation coil portion by way of conductive respective ones of the first vias.

22. (Currently Amended) The printed circuit board as claimed in claim 21, wherein:

each of the plurality of first excitation coil upper portions of the first excitation coil portion substantially faces the plurality of first corresponding first excitation coil lower portions portion of the first excitation coil portion with at least a portion one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending therebetween between and overlapping the first upper portion and the corresponding first lower portion of the first excitation coil portion, and

each of the plurality of second excitation coil upper portions of the second excitation coil portion substantially faces the plurality of second corresponding second excitation coil lower portions portion of the second excitation coil portion with at least a portion one of the bar-type portions of the second pair of parallel bar-type portions of the second soft magnetic core extending therebetween between and overlapping the second upper portion and the corresponding second lower portion of the second excitation coil portion.

23. (Currently Amended) The printed circuit board as claimed in claim 68 [[22]], wherein:

each of the plurality of first pick-up coil upper portions of the first pick-up coil portion substantially faces the plurality of first corresponding first pick-up coil lower portions

portion of the first pick-up coil portion with at least a portion of one of the bar type portions of the first pair of parallel bar type portions of the first soft magnetic core extending therebetween between and overlapping the first upper portion and the corresponding first lower portion of the first pick-up coil portion, and

each of the plurality of second pick-up coil upper portions of the second pick-up coil portion substantially faces the plurality of second corresponding second pick-up coil lower portions portion of the second pick-up coil portion with at least a portion of one of the bar type portions of the second pair of parallel bar type portions of the second soft magnetic core extending therebetween between and overlapping the second upper portion and the corresponding second lower portion of the second pick-up coil portion.

24-25. (Cancelled).

26. (Currently Amended) The printed circuit board as claimed in claim 17, wherein:

the first excitation coil portion alternately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core together in a figure-eight pattern extending along the first axial direction, and

the second excitation coil portion alternately winds around each bar-type portion of the third second parallel pair of bar-type portions of the second soft magnetic core together in a figure eight pattern extending along the second axial direction.

27. (Currently Amended) The printed circuit board as claimed in claim 26, wherein:

the first pick-up coil ~~portion~~ winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction, and

the second pick-up coil ~~portion~~ winds around both bar-type portions of the third ~~second~~ parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction.

28. (Previously Presented) The printed circuit board as claimed in claim 27 [[26]], wherein:

~~the first pick-up coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction,~~

~~the second pick-up coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second soft magnetic core together in a solenoid pattern extending along the second axial direction,~~

the first excitation coil and the first pick-up coil wrap around the first soft magnetic core as a single layer,

the second excitation coil and the second pick-up coil wrap around the second soft magnetic core as a single layer,

the winding of the first pick-up coil ~~portion~~ is off-set in the first axial direction from the winding of the first excitation coil ~~portion~~, and

the winding of the second pick-up coil ~~portion~~ is off-set in the second axial direction from the winding of the second excitation coil ~~portion~~.

29. (Currently Amended) The printed circuit board as claimed in claim 26, wherein:

the first pick-up coil ~~portion~~ separately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first axial direction, and

the second pick-up coil ~~portion~~ separately winds around each bar-type portion of the third ~~second~~ parallel pair of bar-type portions of the second soft magnetic core in a solenoid pattern extending along the second axial direction.

~~the winding of the first pick-up coil portion is off set from the winding of the first excitation coil portion, and~~

~~the winding of the second pick-up coil portion is off set from the winding of the second excitation coil portion.~~

30-65. (Cancelled).

66. (Currently Amended) The printed circuit board as claimed in claim 1, wherein at least a portion of the dielectric substrate is sandwiched between the first pick-up coil ~~portion~~ and the second pick-up coil ~~portion~~.

67. (Currently Amended) The printed circuit board as claimed in claim 66 [[1]], wherein at least a portion of the dielectric substrate is sandwiched between the first excitation coil ~~portion~~ and the second excitation coil ~~portion~~.

68. (New) The printed circuit board as claimed in claim 21, wherein:

the first pick-up coil includes a plurality of first pick-up coil upper portions on the first surface of the dielectric substrate and a plurality of corresponding first pick-up coil lower portions on the first surface of the dielectric substrate, the plurality of first pick-up coil upper

portions being arranged further from the first surface of the dielectric substrate than the plurality of corresponding first pick-up coil lower portions,

the second pick-up coil includes a plurality of second pick-up coil upper portions on the second surface of the dielectric substrate and a plurality of corresponding second pick-up coil lower portions on the second surface of the dielectric substrate, the plurality of second pick-up coil upper portions being arranged further from the second surface of the dielectric substrate than the plurality of corresponding second pick-up coil lower portions,

the plurality of first pick-up coil upper portions correspond to a patterned conductive layer,

the plurality of corresponding first pick-up coil lower portions correspond to a patterned conductive layer,

the first pick-up coil upper portions are electrically connected with corresponding first pick-up coil lower portions by conductive vias,

the plurality of second pick-up coil upper portions correspond to a patterned conductive layer,

the plurality of corresponding second pick-up coil lower portions correspond to a patterned conductive layer, and

the second pick-up coil upper portions are electrically connected with corresponding second pick-up coil lower portions by conductive vias.

69. (New) The printed circuit board as claimed in claim 68, wherein:

the plurality of first excitation coil upper portions and the plurality of first pick-up coil upper portions correspond to a first patterned conductive layer,

the plurality of corresponding first excitation coil lower portions and the plurality of corresponding first pick-up coil lower portions correspond to a second patterned conductive layer,

the plurality of second excitation coil upper portions and the plurality of second pick-up coil upper portions correspond to a third patterned conductive layer, and

the plurality of corresponding second excitation coil lower portions and the plurality of corresponding second pick-up coil lower portions correspond to a fourth patterned conductive layer.

70. (New) The printed circuit board as claimed in claim 29, wherein:

the first excitation coil and the first pick-up coil wrap around the first soft magnetic core as a single layer,

the second excitation coil and the second pick-up coil wrap around the second soft magnetic core as a single layer,

the winding of the first pick-up coil is off-set in the first axial direction from the winding of the first excitation coil, and

the winding of the second pick-up coil is off-set in the second axial direction from the winding of the second excitation coil.